

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

In The Claims

Below is a clean version of the entire set of pending claims pursuant to 37 C.F.R. 1.121(c)(3)(i). Only claim 4 has been amended in this Amendment and Response to Office Action.

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1. (Previously Amended) A target irradiation system comprising:
an x-ray source operable to emit x-rays;
a target object capable of becoming radioactive upon receiving the emitted x-rays;
a relative positioning apparatus operable to translate the target object relative to the x-rays.
 2. (Previously Amended) The system as set out in claim 1 wherein said x-ray source includes a medical or industrial linear accelerator having an x-ray generating target.
 3. (Previously Amended) The system as set out in claim 1 wherein said x-ray source includes means for emitting an x-ray beam including said x-rays and said system further comprising a means for shaping said x-ray beam.
 4. (Currently Amended) The system as set out in claim 1 wherein said target object comprises an implantable medical object ~~a medical stent~~.
 5. (Previously Amended) The system as set out in claim 1 wherein said relative positioning system includes a rotatable carousel at least a portion of which is impinged upon by and receives at least a portion of said x-rays, said rotatable carousel including at least one target mount for retaining at least one target object in fixed relation to said rotatable carousel.
 6. (Previously Amended) The system as set out in claim 5 wherein said rotatable carousel has at least one rotation angle at which each said at least one target mount is impinged upon by and receives said x-rays emitted from said x-ray source and at least one rotation angle at which said at least one target mount does not receive said x-rays.
 7. (Previously Amended) The system as set out in claim 1 wherein said relative positioning apparatus includes a tube assembly having:
a stationary member defining an interior path for receiving the target object; and

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

a translation assembly for moving the target object along a path within said stationary member, said path positioned such that the target object receives said x-rays emitted from said x-ray source.

8. (Previously Amended) The system as set out in claim 7 wherein said stationary member defining an interior path is a tube.

9. (Previously Amended) The system as set out in claim 7 wherein said tube assembly further comprises a heat transfer apparatus supplying a heat transfer fluid within the interior of said stationary member defining an interior path.

10. (Previously Amended) The system as set out in claim 7 wherein said translation assembly includes linear and rotational translation apparatus.

11. (Previously Amended) The system as set out in claim 7 further comprising a plurality of members each defining an interior path and having an associated translation assembly for moving at least one target object along said interior path within each said member defining an interior path, each said interior path positioned to be impinged upon by said x-rays emitted from said x-ray source.

12. (Previously Amended) The system as set out in claim 7 wherein said stationary member defining an interior path includes an x-ray source activated by said beam of electrons to emit x-rays.

13. (Previously Amended) The system as set out in claim 1 wherein said relative positioning apparatus includes a tube assembly having:

a substantially stationary tube defining an internal target object conduit path; and
a translation assembly for moving the target object within said stationary tube along a desired path positioned to be impinged upon by said x-rays emitted from said x-ray source.

14. (Previously Amended) The system as set out in claim 1 further comprising:
at least one sensor measuring parameters selected from a group including electron beam current, temperature, and radiation; and
a control circuit controlling the electron beam provided by said electron beam source based

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

on said parameters measured by said at least one sensor.

15. (Previously Amended) The system as set out in claim 14 wherein said at least one sensor includes a radiation detector situated downstream of said relative positioning apparatus.

16. (Previously Amended) The system as set out in claim 14 wherein said at least one sensor includes a metering circuit measuring the electric current received in an x-ray conversion target.

17. (Previously Amended) The system as set out in claim 14 wherein said at least one sensor includes a temperature monitoring device measuring the temperature in proximity of said relative positioning apparatus.

18. (Previously Amended) The system as set out in claim 14 wherein said at least one sensor includes:

a radiation detector situated downstream of said relative positioning apparatus; and
a metering circuit measuring the electric current received in an x-ray conversion target.

19. (Previously Amended) The system as set out in claim 1 further comprising a radiation detector downstream of said relative positioning apparatus.

20. (Previously Amended) The system as set out in claim 2 wherein said x-ray conversion target further comprises a metering circuit measuring the electron beam current received by the x-ray conversion target.

21. (Previously Amended) The system as set out in claim 1 wherein said relative positioning apparatus includes a fixed positioning member retaining at least one target object in generally fixed relation to said x-ray source while positioned in the path of said x-rays.

22. (Previously Amended) The system as set out in claim 1 further comprising an electron beam directing apparatus between the electron beam source and an x-ray conversion target.

23. (Previously Amended) The system as set out in claim 22 wherein said electron beam directing apparatus includes a magnetic means for directing the electron beam.

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

24. (Previously Amended) The system as set out in claim 1 further comprising a heat transfer system conducting heat away from an x-ray conversion target.

25. (Previously Amended) The system as set out in claim 24 wherein said heat transfer system includes a conduit for conveying a heat transfer fluid.

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26. (Previously Amended) The system as set out in claim 1 further comprising a thermal shield between an x-ray conversion target and at least one target object positioned on said relative positioning apparatus.

27. (Previously Amended) The system as set out in claim 1, further comprising an x-ray conversion target includes a plurality of layers wherein:

at least a first one of said layers comprises x-ray generating material;

at least a second one of said layers comprises an electron absorption apparatus between said x-ray generating material layer and said at least one target object positioned by said relative positioning apparatus.

28. (Previously Amended) The system as set out in claim 27 further comprising a thermal shield between said x-ray conversion target and said relative positioning apparatus.

29. (Previously Amended) The system as set out in claim 1 further comprising a chamber downstream of the x-ray source, said chamber including a target object entry port and wherein said relative positioning apparatus includes a translation armature extendable through said target object entry port.

30. (Previously Amended) The system as set out in claim 29 wherein said translation armature includes a linearly translatable member mounting for receiving said at least one target object wherein the linearly translatable member defines a translation path including a first position within said chamber impinged upon by said x-rays, and a second position outside said chamber wherein said at least one target object is movable on said linearly translatable member between said first position and said second position, through said entry port.

31. (Previously Amended) Apparatus for irradiating a target object comprising:

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

an electron beam source providing a beam of electrons;

a positioning assembly including a rotatable carousel having an axis of rotation and a radial edge, the electron beam source directing said beam of electrons to impinge upon and be received by the radial edge of said rotatable carousel, said rotatable carousel including:

an x-ray conversion target in the rotatable carousel activated by said beam of electrons to emit x-rays;

a mounting station receiving at least one target object, said mounting station receiving x-rays emitted by said x-ray conversion target.

32. (Previously Amended) The apparatus as set out in claim 31 wherein said positioning assembly includes a plurality of mounting stations each mounting at least one target object in a generally fixed relation to said x-ray conversion target.

33. (Previously Amended) The apparatus as set out in claim 31 wherein said electron beam is directed perpendicular to the axis of rotation of said rotatable carousel.

34. (Previously Amended) The apparatus as set out in claim 33 wherein said x-ray conversion target is located in said rotatable carousel.

35. (Previously Amended) The apparatus as set out in claim 33 wherein said carousel includes a carbon-carbon fiber doped with said x-ray generating material.

36. (Previously Amended) The apparatus as set out in claim 31 wherein said rotatable carousel is rotatable from a first position in which said mounting station is aligned with said electron beam and a second position in which said mounting station is outside the path of said electron beam.

37. (Previously Amended) The apparatus as set out in claim 31 further comprising a heat transfer system conducting heat away from at least one of the carousel, x-ray conversion target and target object.

38. (Previously Amended) The apparatus as set out in claim 37 wherein said heat transfer system includes a conduit for conveying a heat transfer fluid.

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

39. (Previously Amended) The apparatus as set out in claim 37 wherein said heat transfer system includes a plurality of fluid conduits in said rotatable carousel.

40. (Previously Amended) The apparatus as set out in claim 31 further comprising an electron beam directing apparatus between said electron beam source and said carousel.

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41. (Previously Amended) A target irradiation system comprising:
an electron beam source providing a beam of electrons;
a positioning assembly including a linearly movable translation armature, said translation armature mounted to said positioning assembly at least for linear motion in an axial direction, and said translation armature including a mounting apparatus mounting at least one target object;
an x-ray conversion target mounted on said translation armature between said translation armature and said electron beam source, wherein said x-ray conversion target defines a radial access region providing access to said at least one target object and said x-ray conversion target includes an x-ray generating material activated by said beam of electrons to emit x-rays; and
a target object capable of becoming radioactive upon receiving the emitted x-rays.

42. (Previously Amended) The system as set out in claim 41 wherein:
said positioning assembly includes a means for moving said x-ray conversion target mounted on said translation armature between a first position range impinged upon by said electron beam, and a second x-ray conversion target position not impinged upon by said electron beam; and
said positioning assembly includes a means for moving said at least one target object mounted on said mounting apparatus between a first target object position range corresponding to said first x-ray conversion target position range at which said at least one target object is positioned in the path of x-rays emitted by said x-ray conversion target and a second target object position not impinged upon by said electron beam.

43. (Previously Amended) The system as set out in claim 41 further comprising an irradiation enclosure defining an interior space wherein said first x-ray conversion target position and said first target object position are within the interior space defined by said irradiation enclosure and said second x-ray conversion target position and said second target object position are outside said irradiation enclosure.

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

44. (Previously Amended) The system as set out in claim 41 wherein said x-ray conversion target is substantially planar.

45. (Previously Amended) The system as set out in claim 41 wherein said x-ray conversion target has an arcuate cross-sectional shape.

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46. (Previously Amended) A target irradiation system comprising:
an electron beam source providing a beam of electrons on a path;
a rotatable carousel including:

a plurality of x-ray conversion targets circumferentially positioned on said carousel, each of said plurality of x-ray conversion targets including an x-ray generating material activated by said beam of electrons to emit x-rays when positioned in the path of the electron beam;

a plurality of mounting stations to receive at least one of said target objects, each of said mounting stations associated with one of said x-ray conversion targets and located on said carousel downstream its associated x-ray conversion target in the path of x-rays emitted from the associated x-ray conversion target when the x-ray generating material of the associated x-ray conversion target is activated by said beam of electrons to emit x-rays; and
a target object capable of becoming radioactive upon receiving the emitted x-rays.

47. (Previously Amended) A target irradiation system comprising:
an electron beam source providing a beam of electrons;
an x-ray conversion target in fixed relation to the electron beam source in the path of the beam of electrons from the electron beam source, the x-ray conversion target including an x-ray generating material activated by the beam of electrons to emit said x-rays;
a target object capable of becoming radioactive upon receiving the emitted x-rays;
an electron beam directing apparatus between the electron beam source and the x-ray conversion target; and

a retaining apparatus retaining the target object in relation to said electron beam source.

48. (Previously Amended) A target irradiation system comprising:
an x-ray source means for generating x-rays; and

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

a positioning means for positioning at least one target object in the path of said x-rays generated by said x-ray source means, including means for moving at least one target object in relation to said x-rays generated by said x-ray source means; and
a target object capable of becoming radioactive upon receiving the generated x-rays.

49. (Previously Amended) The system as set out in claim 48 wherein said x-ray source comprises:

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an electron beam source means providing a beam of electrons;
an x-ray conversion target means in fixed relation to the electron beam source in the path of the beam of electrons from the electron beam source, the x-ray conversion target including an x-ray generating material means for emitting x-rays when activated by said beam of electrons.

50. (Previously Amended) The system as set out in claim 47 wherein said positioning means comprises a carousel means including target object mounting means.

51. (Previously Amended) A target irradiation system comprising:
an electron beam source providing a beam of electrons;
a positioning means including a means for linearly translating a translation armature for linear motion in an axial direction, and said translation armature including a mounting means for retaining at least one target object;

an x-ray conversion target means mounted on said translation armature between said translation armature and said electron beam source, wherein said x-ray conversion target means defines a radial access region providing access to said at least one target object and said x-ray conversion target includes an x-ray generating material activated by said beam of electrons to emit x-rays; and

a target object capable of becoming radioactive upon receiving the emitted x-rays.

52. (Previously Amended) A method of irradiating a target object comprising:
providing a beam of electrons;
positioning an x-ray conversion target in fixed relation to said beam of electrons and impinging upon and receiving said beam of electrons;
emitting x-rays from the x-ray conversion target when activated by said beam of electrons;

Attorney Docket No.: 67110070.1003
Serial No. 09/379,439

selecting a target object capable of becoming radioactive upon receiving the emitted x-rays;
moving at least one of target object in relation to said x-ray conversion target and in the path
of the x-rays emitted by said x-ray conversion target.

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53. (Previously Amended) A method of irradiating a target object in a rotatable carousel
having an axis of rotation comprising:

selecting a target object capable of becoming radioactive upon receiving x-rays;
placing the target object in an aperture in the rotatable carousel;
providing a beam of electrons substantially perpendicular to said axis of rotation of the
carousel;

activating an x-ray generating material in the rotatable carousel with said beam of electrons to
emit x-rays; and

impinging at least a portion of said x-rays upon the target object placed in the aperture.

54. (Previously Amended) An irradiated medical stent produced using a process
comprising the steps of:

providing a beam of electrons;

providing an x-ray conversion target in fixed relation to the beam of electrons;

emitting x-rays from the x-ray conversion target when activated by said beam of electrons;

and

moving at least one medical stent in the path of said x-rays emitted by the x-ray conversion
target.